Claims

1. A coherent laser radar device, comprising:

a laser source that oscillates a laser beam which is linearly polarized;

a first optical coupler that is formed of a polarization maintained type optical element that branches the laser beam from the laser source into two lights, a local light and a transmitted light;

an optical modulator that is formed of a polarization maintained type optical element that modulates the transmitted light that is branched by the first optical coupler;

a space type optical amplifier that amplifies the transmitted light which is outputted from the optical modulator over space propagation;

a transmitting/receiving optical system that applies the transmitted light which is amplified by the space type optical amplifier toward a target and receives a scattered light from the target;

a transmitting/receiving light splitting device that splits the transmitted light that is amplified by the space type optical amplifier and the received light that is scattered by the target;

a second optical coupler that is formed of a polarization maintained type optical element that mixes the local light that is branched by the first optical coupler and the received light that is split by the transmitting/receiving light splitting device together;

a photodetector that detects heterodyne of a mixed light from the second optical coupler to output a beat signal of the received light;

a beat signal amplifier that amplifies the beat signal which is outputted from

the photodetector;

a signal processing device that processes a signal that is amplified by the beat signal amplifier; and

a display device that displays a result processed by the signal processing device,

characterized in that an optical path that extends from the laser source to the space type optical amplifier through the first optical coupler, an optical path that extends from the transmitting/receiving light splitting device to the photodetector through the second optical coupler, and an optical path that extends from the first optical coupler to the second optical coupler are connected by polarization maintained type single mode optical fibers.

2. The coherent laser radar device according to claim 1, further comprising:

a polarization controller that adjusts the polarization of the transmitted light that is outputted from the optical modulator such that the polarization monitor output becomes minimum;

an optical fiber amplifier that amplifies the transmitted light which is outputted from the polarization controller;

a polarization splitting coupler that splits the transmitted light which is amplified by the optical fiber amplifier to two linearly polarized components which are orthogonal to each other; and

a polarization monitor that monitors one of the polarized components which are split by the polarization splitting coupler to transmit a polarization monitor output to the polarization controller, characterized in that:

the space type optical amplifier amplifies the other polarized component which is split by the polarization splitting coupler over space propagation as the transmitted light; and

an optical path that extends from the optical modulator to the optical fiber amplifier through the polarization controller in the optical path that extends from the first optical coupler to the space type optical amplifier is connected by a signal mode optical fiber.

3. The coherent laser radar device according to claim 1, further comprising:

a switch that switches over the output of the photodetector between a period of time during which internal scattering of the transmitting/receiving optical system is generated and a period of time during which the scattered light from the target is received; and

a pulse monitor that monitors a signal which is obtained through the switch and attributable to the internal scattering to output a start signal, characterized in that:

the beat signal amplifier amplifies the beat signal of the received signal that is obtained through the switch; and

the signal processing device starts reading of the beat signal that is amplified by the beat signal amplifier on the basis of a start signal that is obtained by the pulse monitor.

4. The coherent laser radar device according to claim 1, further comprising:

a polarization controller that adjusts the polarization of the transmitted light that is outputted from the optical modulator such that the polarization monitor output

becomes minimum;

an optical fiber amplifier that amplifies the transmitted light that is outputted from the polarization controller;

a polarization splitting coupler that splits the transmitted light that is amplified by the optical fiber amplifier to two linearly polarized components that are orthogonal to each other; and

a polarization monitor that monitors one of the polarized components which are split by the polarization splitting coupler to transmit a polarization monitor output to the polarization controller, characterized in that:

the space type optical amplifier amplifies the other polarized component which is split by the polarization splitting coupler over space propagation as the transmitted light; and

an optical path that extends from the optical modulator to the optical fiber amplifier through the polarization controller in the optical path that extends from the first optical coupler to the space type optical amplifier is connected by a signal mode optical fiber, and

the coherent laser radar device further comprising:

a switch that switches over the output of the photodetector between a period of time during which internal scattering of the transmitting/receiving optical system is generated and a period of time during which the scattered light from the target is received; and

a pulse monitor that monitors a signal which is obtained through the switch and attributable to the internal scattering to output a start signal, characterized in that:

the beat signal amplifier amplifies the beat signal of the received signal that is

obtained through the switch; and

the signal processing device starts reading of the beat signal that is amplified by the beat signal amplifier on the basis of a start signal that is obtained by the pulse monitor.

5. The coherent laser radar device according to any one of claims 1 to 4, characterized in that the space type optical amplifier comprises:

a collimating optical system that collimates the transmitted light which is outputted from the polarization maintained single mode fiber;

an pumping light source that outputs a pulsed pumping light;

a dichroic mirror that combines the transmitted light that is outputted from the collimating optical system with the pumping light that is outputted from the pumping light source; and

a nonlinear material having an Optical Parametric Amplification (OPA) function that converts a power of the pumping light into a power of the transmitted light and amplifies the transmitted light upon receiving incidence of the transmitted light and the pumping light that are combined together by the dichroic mirror.

6. The coherent laser radar device according to claim 5, characterized in that the space type optical amplifier further comprises two or more nonlinear materials as the nonlinear material, and a split mirror that removes an idler light between the respective nonlinear materials.

7. The coherent laser radar device according to claim 5, characterized in that

Periodic Poled $LiNbO_3$ (MgPPLN) added with magnesium is used as the nonlinear material.

8. The coherent laser radar device according to claim 5, characterized in that a pulse width of the transmitted light from the collimating optical system is made longer than a pulse width of the pumping light from the pumping light source.

9. The coherent laser radar device according to claim 5, characterized in that a pulse width of the transmitted light from the collimating optical system is made shorter than a pulse width of the pumping light from the pumping light source.

10. The coherent laser radar device according to claim 9, characterized in that a pulse width of the transmitted light from the collimating optical system is made variable.